



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/621,999	07/17/2003	Yousheng Shen	011361.00064	2626
22910	7590	01/03/2011	EXAMINER	
BANNER & WITCOFF, LTD. 28 STATE STREET SUITE 1800 BOSTON, MA 02109-1701			OLSEN, KAJ K	
			ART UNIT	PAPER NUMBER
			1724	
			MAIL DATE	DELIVERY MODE
			01/03/2011	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/621,999	SHEN ET AL.	
	Examiner	Art Unit	
	KAJ K. OLSEN	1724	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) Responsive to communication(s) filed on 15 November 2010.
 2a) This action is **FINAL**. 2b) This action is non-final.
 3) Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) Claim(s) 2,17-74,76-108,110,112 and 113 is/are pending in the application.
 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
 5) Claim(s) 30-74 and 76-78 is/are allowed.
 6) Claim(s) 17,79-108,110,112 and 113 is/are rejected.
 7) Claim(s) 2 and 18-29 is/are objected to.
 8) Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) The specification is objected to by the Examiner.
 10) The drawing(s) filed on _____ is/are: a) accepted or b) objected to by the Examiner.
 Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
 Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
 11) The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
 a) All b) Some * c) None of:
 1. Certified copies of the priority documents have been received.
 2. Certified copies of the priority documents have been received in Application No. _____.
 3. Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|---|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. _____ . |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08)
Paper No(s)/Mail Date <u>11/15/2010</u> . | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Res Judicata

1. Claims 95 and 96 of this reissue are identical to claims 79 and 80 presented to the Board of Patent Appeals and Interferences in Reexamination 90/006,208 except that applicant has now incorporated the limitations of claim 109 into claim 95. Claim 109 would appear to be identical to claim 14 from the original reexamination of 90/006,208 except that claim 14 depended from claim 1 and not claim 79 in the original reexamination. However, claims 1 and 79 in the reexamination were identical except that claim 79 specified that the gas in question was carbon monoxide. Claim 8 in the reexamination further limited claim 1 by specifying that the gas being analyzed was carbon monoxide. Hence, amended claim 95 here would appear to be equivalent to the combination of claims 1, 8, and 14 from the reexamination. The examiner was affirmed in the Board decision of 5/23/2007 concerning claims 1, 8, 14, and the pre-amended claim 79. Claim 96 is still equivalent to claim 80 from the previous reexamination. The examiner was affirmed on his rejections of claims 1, 8, 14, previous claim 79, and 80, so there are no limitation in amended claim 79 that the Board has not previously considered. Hence, these claims 95 and 96 are rejected on the grounds of res judicata and the applicant is not entitled to further adjudication of the issues concerning these claims.

Claim Rejections - 35 USC § 112

2. The previous rejection of claim 17 has been withdrawn in view of the amendment.

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

4. The factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

5. Claims 79, 81, 86, 88, and 97 are rejected under 35 U.S.C. 103(a) as being unpatentable over Dempsey et al (USP 4,227,984) in view of Nagata et al (USP 4,913,792) and any of Vanderborgh et al (USP 4,804,592), Uchida et al (USP 5,474,857) and/or Grot et al (USP 5,330,860).

6. With respect to claim 79, Dempsey discloses an electrochemical gas sensor that comprises a sensing electrode 13, a counter electrode 10, with a protonic conductive electrolyte membrane 9 between and in contact with both the sensing and counter electrodes (fig. 2). Dempsey teaches the use of a membrane with a thickness that reads on the claimed thickness (col. 11, lines 58-60). The sensing electrode reacts with the gas to be measured and the sensor has a means for electrical measurement (fig. 3). With respect to the area of the electrodes, see col. 11, lines 65-67. 1.6 cm would read on “approximately...15 mm” giving the claim language

its broadest reasonable interpretation. Dempsey does not explicitly teach the use of sensing and counter electrodes that contain both ionically and electrically conductive materials. Dempsey does recognize that the electrodes set forth in the fuel cell prior art find utility for the sensor of Dempsey (col. 8, lines 30-63). In the fuel cell art, it is common to utilize a combination of ionically and electrically conductive material for the electrodes for fuel cells. In particular, Vanderborgh and Grot teach the use of a combination of said materials and teaches that said combination of materials provides a fuel cell with improved efficiency and internal resistance (col. 2, lines 42 and 43 of Vanderborgh and col. 4, lines 26-29 of Grot). Uchida teaches a particular electrode for use in fuel cells that is a combination of proton conducting material and electrically conducting material. Grot also teaches the use of fuel cell electrodes having both ionically and electrically conductive materials that also satisfy the claimed compositions (col. 4, line 35 through col. 5, line 2; and col. 14, lines 15-27). It would have been obvious to one of ordinary skill in the art at the time the invention was being made to utilize the teachings of any of Vanderborgh, Uchida, and/or Grot for the sensor of Dempsey because these electrodes have shown previous favorable utility in the fuel cell art, and the substitution of one known fuel cell electrode composition for another, when the results are not unexpected, requires only routine skill in the art. Furthermore, the addition of ionically conductive material to the electrode would improve the effective resistance of the electrodes as well as facilitate the removal of the solid-solid interfaces between the electrodes and the membrane (Vanderborgh, col. 2, lines 25-43). Although the secondary references are drawn principally towards fuel cell power sources, Uchida and Grot both recognized the utility of their teachings to fuel cell based sensors like those of Dempsey (see Uchida, col. 10, lines 60-64; and Grot, col. 1, lines 19-30). In addition,

Dempsey recognized the utility of the teachings from the general fuel cell art for the disclosed sensor (col. 8, lines 30-63).

7. Dempsey also did not teach that the sensing and counter electrodes are the only two electrodes in contact with the first protonic conductive electrolyte membrane. Rather Dempsey taught the addition of a third reference electrode 32 that is also in contact with the membrane. However, Nagata teaches that it is not necessary to utilize a reference electrode to stabilize the potential of the working electrode as long as the counter electrode is large enough to help maintain a stable potential at the working electrode. Nagata also teaches that such a two-electrode cell simplifies the circuitry as it obviates the need for a potentiostat to control the potential of the working electrode. Compare fig. 1 with fig. 8 and see col. 7, l. 66 - col. 8, l. 11. Because Nagata teaches that both two and three electrode gas sensors were known in the art and that sensors were readily transferable between the two, and further taught that two-electrode sensors have simplified circuitry, it would have been obvious to one of ordinary skill in the art at the time the invention was being made to utilize only two-electrodes for the sensor of Dempsey in view of Vanderborgh, Uchida, and/or Grot as taught by Nagata because the substitution of one known sensor structure (two-electrode) for another known structure (three-electrode) requires only routine skill in the art. In addition, the use of a two-electrode configuration has the added advantage of being simpler to construct and operate.

8. With respect to claim 81 (those limitations not covered above), because the electrode of Dempsey in view of Vanderborgh, Uchida, and/or Grot already rendered obvious the combination of catalytic electronic conducting material (e.g. Pt) and ion conducting material (e.g. Nafion) for the electrodes with overlapping composition to the electrodes of the instant

invention, then such an electrode would inherently be capable of reacting with a gas in the absence of an applied voltage to the sensing electrode. The fact that Dempsey operates its sensor using an applied voltage to the sensing electrode does not read free of this limitation because whether or not a voltage is applied is how the sensor is to be utilized and does not further define the structure of the device.

9. With respect to claims 86 and 88 (those limitations not covered above), whether or not the sensor is operated at room temperature is only the intended use of the apparatus and the intended use need not be given further due consideration in determining patentability. It is noted however that the sensor of Dempsey can be utilized at room temperature as evidenced by col. 2, ll. 30-35.

10. With respect to new claim 97, this claim appears to comprise almost entirely limitations already addressed previously. With respect to the use of the specified copolymer of tetrafluoroethylene backbone with a side chain of perfluorinated monomers containing a sulfonic group, each of Vanderborgh, Uchida, and Grot specify the use of Nafion as the polymer being mixed with the electrode material (see the discussion above) and Nafion is inherently a copolymer of tetrafluoroethylene backbone with a side chain of perfluorinated monomers containing a sulfonic group. See the present invention specification col. 6, ll. 40-46. With respect to the specified thickness of 0.17 mm for the membrane, it would have been obvious to one of ordinary skill in the art at the time the invention was being made to utilize a thinner membrane than that set forth by Dempsey in order to further reduce the internal resistance of the sensor. With respect to approximately 0.17 mm, finding the optimal thickness requires only routine skill in the art. In re Boesch, 617 F.2d 272, 205 USPQ 215 (CCPA 1980). With respect

to the specific use of 15 mm for the sensing electrode, this is so close to the 16 mm of Dempsey that it constitutes an obvious difference over the area relied on by Dempsey. There is no particular criticality disclosed by the present invention for the specific use of 15 mm, nor is there any criticality to the use of 16 mm by the teaching of Dempsey. Both the thickness and diameter positions were affirmed in the Appeal decision of 90/006,208.

11. Claims 17, 79-101, 103-106, 108, 110, 112, and 113 are rejected under 35 U.S.C. 103(a) as being unpatentable over Tomantschger et al (USP 5,173,166) (hereafter "Tomantschger '166") in view of Dempsey and any or Vanderborgh, Uchida, and/or Grot.

12. With respect to claim 79, Tomantschger '166 discloses a two-electrode electrochemical gas sensor for measuring a gas in an ambient atmosphere (col. 5, ll. 27-32) comprising a porous sensing electrode 12 containing electronically conducting material, a porous counter electrode 16 also containing electronically conducting material (col. 8, ll. 13-20 and examples 1-5 of col. 12), and a first protonic conductive electrolyte membrane 24 (col. 6, ll. 61-63) in between and in contact with the sensing and counter electrodes where the sensing and counter electrodes are the only two electrodes in contact with the membrane (fig. 3 for example). Tomantschger '166 discloses that the sensing electrode reacts with the gas to produce a change in electrical characteristic (either a potential or a current) between the sensing electrode and counter electrode (col. 7, ll. 21-33), whereby in a positive ambient concentration of said gas, said electrical measurement detects changes in said electrical characteristics (fig. 6 and 7). Tomantschger '166 does not explicitly disclose the addition of an ionically conducting material to the electrodes of the sensor. However, it is noted that Tomantschger '166 admits that its sensor is essentially functioning as a fuel cell device. See col. 8, ll. 23-28. In the fuel cell art, it is common to utilize

a combination of ionically and electrically conductive material for the electrodes for fuel cells.

In particular, Vanderborgh and Grot teach the use of a combination of said materials and teaches that said combination of materials provides a fuel cell with improved efficiency and internal resistance (col. 2, lines 42 and 43 of Vanderborgh and col. 4, lines 26-29 of Grot). Uchida teaches a particular electrode for use in fuel cells that is a combination of proton conducting material and electrically conducting material. Grot also teaches the use of fuel cell electrodes having both ionically and electrically conductive materials that also satisfy the claimed compositions (col. 4, line 35 through col. 5, line 2; and col. 14, lines 15-27). Vanderborgh teaches the use of 19 wt% Nafion to 81 wt% of the total C and Pt concentration (see Table 1); Uchida teaches the use of 13 wt% Nafion (col. 7, l. 63 - col. 8, l. 26); and Grot teaches the use of 0-25 wt% Nafion (col. 4, ll. 44-55). It would have been obvious to one of ordinary skill in the art at the time the invention was being made to utilize the teachings of any of Vanderborgh, Uchida, and/or Grot for the electrodes of Tomantschger '166 for the sensor of Tomantschger '166 because these electrodes have shown previous favorable utility in the fuel cell art, and the substitution of one known fuel cell electrode composition for another, when the results are not unexpected, requires only routine skill in the art. Furthermore, the addition of ionically conductive material to the electrode of Tomantschger '166 would improve the effective resistance of the electrodes as well as facilitate the removal of the solid-solid interfaces between the electrodes and the membrane (Vanderborgh, col. 2, lines 25-43). Hence, it would have been obvious to one of ordinary skill in the art at the time the invention was being made to add ionically conducting material to the electronically conducting electrodes of Tomanstscher in order to increase the electrode efficiency and reduce its resistance. Uchida and Grot both

recognized the utility of their teachings to fuel cell based sensors like those of Tomantschger ‘166 (see Uchida, col. 10, lines 60-64; and Grot, col. 1, lines 19-30).

13. Tomantschger ‘166 also did not explicitly disclose either a particular diameter for its electrodes or a particular thickness of protonic conductive electrolyte membrane. However, the previously relied on Dempsey taught for a different CO sensor that electrodes having a diameter of 16 mm with a Nafion membrane having a thickness overlapping the claimed range provided suitable dimensions for the electrodes and membrane. See col. 11, ll. 58-68. The examiner takes the position that 16 mm either reads on “approximately 1 mm to 15 mm” or is so close to 1-15 mm as to not constitute a patentable distinction. This position was affirmed in the appeal decision for Reexamination 90/006,208 dated 5/23/2007. It would have been obvious to one of ordinary skill in the art at the time the invention was being made to utilize the electrode and electrolyte dimensions from Dempsey for the electrodes and electrolyte of Tomantschger ‘166 because these dimensions have been previously shown to provide effective CO sensitivity. Because Tomantschger ‘166 did not explicitly disclose any dimensions of electrode diameter or electrolyte thickness, this would lead one possessing ordinary skill in the art to conclude that electrode area and membrane thickness were not critical to the sensor of Tomantschger ‘166 and would have though to utilize dimensions disclosed from previous successful CO monitors for the construction of the sensor disclosed by Tomantschger ‘166. The teaching of Dempsey was already identified by Tomantschger ‘166 as being an effective prior art sensor. See Tomantschger ‘166, col. 3, ll. 15-20.

14. With respect to claim 80 (those limitations not covered above), the sensing electrode of Tomantschger ‘166 produces an electrical change in the absence of any applied voltage. See col. 7, ll. 26-33.
15. With respect to claim 81, see the discussion of claims 79 and 80 above.
16. With respect to claims 82-85 (those limitations not covered above), the sensing and counter electrodes are on opposite sides of the protonic conductive electrolyte membrane (see fig. 3).
17. With respect to claim 17, Tomantschger ‘166 describes electrodes formed from noble metals in combination with carbon or graphite (col. 6, ll. 28-33), and ruthenium (Ru) is a noble metal. Further Grot identifies ruthenium and reduced oxides thereof as a suitable catalytic material that may be used with a carbon black support, such as that sold under the VULCAN trade designation (col. 4, ll. 56-61). One of ordinary skill in the art would have been motivated to form an electrode having the claimed percentages of ruthenium oxide and carbon black as Tomantschger ‘166 describes electrodes formed from noble metals and as Grot and Uchida teach that suitable electrodes for gas sensing applications may be formed having the claimed percentages of noble metals, such as ruthenium oxide, and carbon.
18. With respect to claims 86-91 (those limitations not discussed above), Tomantschger ‘166 operates its sensor at room temperature. See col. 5, ll. 27-32.
19. With respect to claims 92-94 (those limitations not covered above), Tomantschger ‘166 is a non-biased device as they apply no biasing potential to the electrodes.
20. With respect to new claim 95, see the rejection of claim 80 above and note that Tomantschger ‘166 already suggested the measurement of carbon monoxide (fig. 6 and 7).

21. With respect to claim 96, element 14 of Tomantschger '166 reads on the defined cap of the claims.

22. With respect to claim 97, see the discussion of the previous claims above where most of these limitations were previously covered. With respect to the use of the specified copolymer of tetrafluoroethylene backbone with a side chain of perfluorinated monomers containing a sulfonic group, each of Vanderborgh, Uchida, and Grot specify the use of Nafion as the polymer being mixed with the electrode material (see the discussion above) and Nafion is inherently a copolymer of tetrafluoroethylene backbone with a side chain of perfluorinated monomers containing a sulfonic group. See the present invention specification col. 6, ll. 40-46. With respect to the specified thickness of 0.17 mm for the membrane, it would have been obvious to one of ordinary skill in the art at the time the invention was being made to utilize a thinner membrane than that set forth by Dempsey in order to further reduce the internal resistance of the sensor. With respect to approximately 0.17 mm, finding the optimal thickness requires only routine skill in the art. In re Boesch, 617 F.2d 272, 205 USPQ 215 (CCPA 1980). With respect to the specific use of 15 mm for the sensing electrode, this is so close to the 16 mm of Dempsey that it constitutes an obvious difference over the area relied on by Dempsey. There is no particular criticality disclosed by the present invention for the specific use of 15 mm, nor is there any criticality to the use of 16 mm by the teaching of Dempsey. Both the thickness and diameter positions were affirmed in the Appeal decision of 90/006,208.

23. With respect to claims 98 and 99, see Tomantschger '166 col. 12, ll. 10-55; Dempsey col. 7, ll. 65-68; Uchida col. 7, l. 55 - col. 8, l. 26; Grot col. 4, l. 35 - col. 5, l. 2 and col. 14, ll. 15-27; and Vanderborgh, table 1.

Art Unit: 1724

24. With respect to claim 100, see Dempsey col. 8, ll. 1-29.
25. With respect to claim 101, see Tomantschger '166 col. 11, ll. 3-6
26. With respect to claims 103-106, see Tomantschger '166 claim 20 of the Dempsey abstract.
27. With respect to claim 108 (those limitations not covered above), it would have been obvious to one of ordinary skill in the art at the time the invention was being made to utilize smaller electrodes for the sensor of Tomantschger in order to make a more compact sensor that utilizes lesser amounts of expensive materials like platinum.
28. With respect to claims 110, 112, and 113, see the discussion of Vanderborgh, Uchida, and Grot above.
29. Claims 17, 80, 82, 84, 87, 89, 91, 92, 95, 96, 98-101, 103, 104, 108, 110, 112, and 113 are rejected under 35 U.S.C. 103(a) as being unpatentable over Dempsey in view of any of Vanderborgh, Uchida and/or Grot.
30. With respect to claim 80, Dempsey discloses an electrochemical gas sensor that comprises a sensing electrode 13, a counter electrode 10, with a protonic conductive electrolyte membrane 9 between and in contact with both the sensing and counter electrodes (fig. 2). Dempsey teaches the use of a membrane with a thickness that reads on the claimed thickness (col. 11, lines 58-60). The sensing electrode reacts with the gas to be measured and the sensor has a means for electrical measurement (fig. 3). With respect to the area of the electrodes, see col. 11, lines 65-67. 1.6 cm would read on "approximately...15 mm" giving the claim language its broadest reasonable interpretation. Dempsey does not explicitly teach the use of sensing and counter electrodes that contain both ionically and electrically conductive materials. Dempsey

does recognize that the electrodes set forth in the fuel cell prior art find utility for the sensor of Dempsey (col. 8, lines 30-63). In the fuel cell art, it is common to utilize a combination of ionically and electrically conductive material for the electrodes for fuel cells. In particular, Vanderborgh and Grot teach the use of a combination of said materials and teaches that said combination of materials provides a fuel cell with improved efficiency and internal resistance (col. 2, lines 42 and 43 of Vanderborgh and col. 4, lines 26-29 of Grot). Uchida teaches a particular electrode for use in fuel cells that is a combination of proton conducting material and electrically conducting material. Grot also teaches the use of fuel cell electrodes having both ionically and electrically conductive materials that also satisfy the claimed compositions (col. 4, line 35 through col. 5, line 2; and col. 14, lines 15-27). It would have been obvious to one of ordinary skill in the art at the time the invention was being made to utilize the teachings of any of Vanderborgh, Uchida, and/or Grot for the sensor of Dempsey because these electrodes have shown previous favorable utility in the fuel cell art, and the substitution of one known fuel cell electrode composition for another, when the results are not unexpected, requires only routine skill in the art. Furthermore, the addition of ionically conductive material to the electrode would improve the effective resistance of the electrodes as well as facilitate the removal of the solid-solid interfaces between the electrodes and the membrane (Vanderborgh, col. 2, lines 25-43). Although the secondary references are drawn principally towards fuel cell power sources, Uchida and Grot both recognized the utility of their teachings to fuel cell based sensors like those of Dempsey (see Uchida, col. 10, lines 60-64; and Grot, col. 1, lines 19-30). In addition, Dempsey recognized the utility of the teachings from the general fuel cell art for the disclosed sensor (col. 8, lines 30-63). With respect to the limitation concerning the sensing electrode

reacting with the gas in the absence of an applied voltage, because the electrode of Dempsey in view of Vanderborgh, Uchida, and/or Grot already rendered obvious the combination of catalytic electronic conducting material (e.g. Pt) and ion conducting material (e.g. Nafion) for the electrodes with overlapping composition to the electrodes of the instant invention, then such an electrode would inherently be capable of reacting with a gas in the absence of an applied voltage to the sensing electrode. The fact that Dempsey operates its sensor using an applied voltage to the sensing electrode does not read free of this limitation because whether or not a voltage is applied is how the sensor is to be utilized and does not further define the structure of the device.

31. With respect to claims 82 and 84 (those limitations not covered above), the sensing and counter electrodes (31, 33) of Dempsey are on opposite sides of the protonic conductive membrane. See fig. 3.

32. With respect to claim 17, Dempsey describes electrodes formed from noble metals and in particular platinum metals (col. 7, l. 65 – col. 8, l. 1) and ruthenium (Ru) is a platinum group metal and a noble metal. Further Grot identifies ruthenium and reduced oxides thereof as a suitable catalytic material that may be used with a carbon black support, such as that sold under the VULCAN trade designation (col. 4, ll. 56-61). One of ordinary skill in the art would have been motivated to form an electrode having the claimed percentages of ruthenium oxide and carbon black as Dempsey describes electrodes formed from noble metals and as Grot and Uchida teach that suitable electrodes for gas sensing applications may be formed having the claimed percentages of noble metals, such as ruthenium oxide, and carbon.

33. With respect to claims 87, 89, and 91 (those limitations not covered above) whether or not the sensor is operated at room temperature is only the intended use of the apparatus and the

intended use need not be given further due consideration in determining patentability. It is noted however that the sensor of Dempsey can be utilized at room temperature as evidenced by col. 2, ll. 30-35.

34. With respect to claim 92, specifying that the sensor is non-biased in the preamble does not further define the structure of the sensor and merely constitutes the intended use of the structure. Alternatively, the sensor of Dempsey would be non-biased when the potentiostat connected to the electrodes is either disconnected or turned off.

35. With respect to new claims 95, 96, 98-101, 103, 104, 108, 110, 112, and 113, see the rejection for claims 79, 80, 3-6, 8, 9, 13-16, and 75 over this same art from Reexamination 90/006,208. The examiner was affirmed in his rejection of those claims.

36. Claims 83, 85, 90, 93, and 94 are rejected under 35 U.S.C. 103(a) as being unpatentable over Dempsey in view of any or Vanderborgh, Uchida, and/or Grot as applied to claims 82, 89, and 92 above, and further in view of Nagata.

37. The examiner notes that claim 94 was previously rejected over the teachings of Dempsey in view of any of Vanderborgh, Uchida, and/or Grot. However, the examiner noticed that claim 94 actually depends from claim 93 and not claim 92, so this claim is now being listed in this rejection. This change for claim 94 is not a change in the grounds of rejection, but merely a correction to reflect the appropriate claim dependence for claim 94.

38. With respect to claims 83, 90, 93, and 94 (those limitations not covered previously), the references set forth all the limitations of the claims, but did not specify that the sensing electrode and the counter electrode are the only two electrodes in contact with the electrolyte membrane. Rather Dempsey taught the addition of a third reference electrode 32 that is also in contact with

the membrane. However, Nagata teaches that it is not necessary to utilize a reference electrode to stabilize the potential of the working electrode as long as the counter electrode is large enough to help maintain a stable potential at the working electrode. Nagata also teaches that such a two-electrode cell simplifies the circuitry as it obviates the need for a potentiostat to control the potential of the working electrode. Compare fig. 1 with fig. 8 and see col. 7, l. 66 - col. 8, l. 11. Because Nagata teaches that both two and three electrode gas sensors were known in the art and that sensors were readily transferable between the two, and further taught that two-electrode sensors have simplified circuitry, it would have been obvious to one of ordinary skill in the art at the time the invention was being made to utilize only two-electrodes for the sensor of Dempsey in view of Vanderborgh, Uchida, and/or Grot as taught by Nagata because the substitution of one known sensor structure (two-electrode) for another known structure (three-electrode) requires only routine skill in the art. In addition, the use of a two-electrode configuration has the added advantage of being simpler to construct and operate.

39. With respect to claim 85, because the electrode of Dempsey in view of Vanderborgh, Uchida, and/or Grot already rendered obvious the combination of catalytic electronic conducting material (e.g. Pt) and ion conducting material (e.g. Nafion) for the electrodes with overlapping composition to the electrodes of the instant invention, then such an electrode would inherently be capable of reacting with a gas in the absence of an applied voltage to the sensing electrode. The fact that Dempsey operates its sensor using an applied voltage to the sensing electrode does not read free of this limitation because whether or not a voltage is applied is how the sensor is to be utilized and does not further define the structure of the device.

Art Unit: 1724

40. Claim 102 is rejected under 35 U.S.C. 103(a) as being unpatentable over Dempsey with any of Vanderborgh, Uchida, or Grot as applied to claim 82 above, and further in view of Tomantschger et al (USP 5,302,274) (hereafter “Tomantschger ‘274”).

41. The references set forth all the limitations of the claims, but did not explicitly recite the use of a metal oxide protonic conductor electrolyte. Tomantschger ‘274 teaches in an alternate gas sensor a number of different electrolyte materials useable as for gas sensors including a uranyl hydrogen phosphate tetrahydrate (col. 8, lines 37 and 38). It would have been obvious to one of ordinary skill in the art at the time the invention was being made to utilize the teaching of Tomantschger ‘274 for the sensor Dempsey in view of any of Vanderborgh, Grot or Uchida because the substitution of one known electrolyte means for another, when the results are not unexpected, requires only routine skill in the art.

42. Claim 102 is rejected under 35 U.S.C. 103(a) as being unpatentable over Tomantschger ‘166 in view of Dempsey and any or Vanderborgh, Uchida, and/or Grot as applied to claim 82 above, and further in view of Tomantschger ‘274.

43. The references set forth all the limitations of the claims, but did not explicitly recite the use of a metal oxide protonic conductor electrolyte. Tomantschger ‘274 teaches in an alternate gas sensor a number of different electrolyte materials useable as for gas sensors including a uranyl hydrogen phosphate tetrahydrate (col. 8, lines 37 and 38). It would have been obvious to one of ordinary skill in the art at the time the invention was being made to utilize the teaching of Tomantschger ‘274 for the sensor Tomantschger ‘166 in view of Dempsey and any of Vanderborgh, Grot or Uchida because the substitution of one known electrolyte means for another, when the results are not unexpected, requires only routine skill in the art.

Art Unit: 1724

44. Claims 105 and 106 are rejected under 35 U.S.C. 103(a) as being unpatentable over Dempsey in view of any of Vanderborgh, Uchida, or Grot as applied to claim 82 above, and further in view of La Conti.

45. The references set forth all the limitations of the claim, but did not specifically teach the sensor be “adapted” to detect hydrogen or H₂S. La Conti teaches in an analogous sensor that these sensors can be adapted to the detection of materials such as hydrogen and H₂S (see Table 1). It would have been obvious to one of ordinary skill in the art at the time the invention was being made to utilize the teaching of La Conti for the sensor of Dempsey in order to extend the utility of the sensor to other gases.

46. Claim 107 is rejected under 35 U.S.C. 103(a) as being unpatentable over Dempsey in view of any of Vanderborgh, Uchida, or Grot as applied to claim 82 above, and further in view of Razaq (USP 5,322,602).

The references set forth all the limitations of the claims, but do not explicitly teach the adapting the sensor for use as a water sensor. Razaq teaches that the sensors like those of Dempsey can also be adapted for use as a water sensor (see abstract). It would have been obvious to one of ordinary skill in the art at the time the invention was being made to utilize the teaching of Razaq for the sensor of Dempsey in order to extend the utility of the sensor to other gases such as water.

47. Claim 107 is rejected under 35 U.S.C. 103(a) as being unpatentable over Tomantschger ‘166 in view of Dempsey and any or Vanderborgh, Uchida, and/or Grot as applied to claim 82 above, and further in view of Razaq.

48. The references set forth all the limitations of the claims, but do not explicitly teach the adapting the sensor for use as a water sensor. Razaq teaches that the sensors like those of Dempsey can also be adapted for use as a water sensor (see abstract). It would have been obvious to one of ordinary skill in the art at the time the invention was being made to utilize the teaching of Razaq for the sensor of Tomantschger '166 in order to extend the utility of the sensor to other gases such as water.

Allowable Subject Matter

49. Claims 2 and 18-29 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

50. Claims 30-74 and 76-78 are allowed.

Response to Arguments

51. Applicant's arguments filed November 15, 2010 have been fully considered but they are not persuasive. The examiner's response to the applicant's arguments will begin with the arguments starting in section III, p. 30 of the response, as section I is a summary of the status of the application and claims and section II is a summary of the arguments applicant makes in detail in section III. The examiner will also restrict his discussion solely to those arguments the examiner hasn't previously analyzed. As a preliminary issue, applicant urges that the examiner is relying on applicant's disclosure for rationale for supporting the rejection over the prior art (items 62, 67 and 69 in the 6/14/2010 office action). This assertion is entirely without merits.

Nowhere in the prior art rejections does the examiner rely on the applicant disclosure to support the rejection. Item 62 concerns the fact that the specification would evidence that a water vapor humidified electrolyte (which was already taught by the prior art LaConti) would not inherently cause the electrodes to be flooded. The use of applicant's disclosure for evidence is entirely consistent with standard office practice as evidence supporting a rejection can come from applicant's own disclosure (see *In re Fitzgerald, Sanders, and Bagheri* 205 USPQ 594, where the similarity between the prior art process and the present invention process evidence that the claimed conditions would have been inherent for the prior art). In items 67 and 69, the examiner is reciting the applicant's disclosure only to rebut applicant arguments. In particular, applicant was attempting to urge that going from three electrode sensors to two electrode sensor would have required more than ordinary skill in the art (even though both Nagata and Tomantschger suggested doing so), or suggested that one cannot utilize electrode dimensions from a three electrode cell for a two electrode cell (even though applicant utilized the same dimensions for each of its electrodes). It was entirely reasonable for the examiner to look to the applicant's own disclosure to see if these arguments had any merit. “[T]he examiner must then consider any evidence supporting the patentability of the claimed invention, such as any evidence in the specification or any other evidence submitted by the applicant” (MPEP 2142) (emphasis added).

52. With respect to the rejection relying on Uchida, applicant challenges the examiner's interpretation of the claimed “mixed conductive material” by relying on the specification that showed the ionic and electronic conductive materials being mixed together to form a single material that is a mixture of the proton and electron conductive materials. When the examiner pointed out that Uchida would teach this even utilizing applicant's more narrow definition of the

claim (see fig. 3 of Uchida), applicant urges that this embodiment where Nafion coated the conductive particles is more akin to marmalade on an English muffin and still wouldn't read on the claim language. This train of argument is unpersuasive for a number of reasons. First, applicant is urging that the precise structure of the disclosed embodiments should be read on the broadly worded claims even though the specification suggests that the scope of the claim should not be so limited by the disclosed embodiments (col. 13, ll. 15-20). Hence, applicant is now essentially urging that the examiner should do what the specification explicitly warned should not be done. Second, if applicant wishes to have the claims be read in such a narrow manner, then why has the applicant not amended the claims as such? Applicant's response was filed after a non-final office action, which would have given the applicant a chance to have the claims read only in this narrower manner. Third, the whole marmalade-muffin analogy that having one material coating another material wouldn't read on the claimed mixture is confusing considering that the embodiments of col. 12 and 13 of the present invention appear to be precisely analogous to the argued marmalade-muffin analogy. In particular, these embodiments disclose how a Pt/carbon powder is added to a Nafion solution, which is eventually dried to form the electrode. Wouldn't conductive particles suspended in a Nafion solution that is eventually dried result in conductive particles being coated with the Nafion? Isn't this essentially the same process utilized by Uchida? Compare col. 5, ll. 28-39 of Uchida with col. 12, ll. 24-27 of the present invention.

53. With respect to Vanderborgh, applicant's arguments appear to rely on the fact that the examiner should construe the claims as being only drawn to the disclosed embodiment of a single layer of a mixture of material even though the claims do not specify a single layer or a

mixture of material. That was not persuasive for the reasons already discussed in the preceding paragraph.

54. With respect to the teaching of Grot, applicant urges that Grot does not suggest the use of further hydrophobic treatment, as suggested by the examiner, because Grot never identified Teflon as being hydrophobic. This argument is puzzling. Teflon is clearly hydrophobic and clearly would control the wetting ability of any electrode that it is added to. Applicant has been urging since the beginning of prosecution of both the reexamination and reissue that the Teflon added to the electrode of Dempsey renders its electrode hydrophobic. Now applicant wants to urge that it is unclear if the Teflon added to Grot would render this electrode more hydrophobic. This argument in the face of the long prosecution history here is clearly untenable.

55. As to the arguments about surfactants only facilitating wetting of an electrode is also incorrect. Surfactants can render hydrophilic material hydrophobic or hydrophobic materials hydrophilic. For example, Rain X is a commercial surfactant utilized to render a windshield hydrophobic so that water will not stick to it. Hence, surfactants can either improve or reduce the wettability of an electrode. Moreover, the surfactants suggested by Grot include fluorinated hydrocarbons which, like Teflon, are typically hydrophobic, and their addition to the electrode would clearly alter the hydrophobic character of the electrode. As to the surfactant being for increasing the dispersibility of the materials, whatever reason they are added will still affect the eventual wettability of the electrode.

56. With respect to the discussion of Surampudi, the only argument the examiner can glean that is new in the continued discussion of this non-relied on teaching is that it demonstrates that fuel cell electrodes are not willy-nilly interchangeable. Whether or not that is the case, it is

unclear why Surampudi need be further discussed. The pending rejections in question are not based on a willy-nilly interchanging of features, but based on explicit suggestions that Nafion be incorporated into gas electrodes for the reasons analogous to the present invention. See the 7/17/2003 examiner's answer in 90/006,209.

57. With respect to the arguments that none of the teachings drawn to further hydrophobic treatments would thereby render the electrodes liquid impermeable, the examiner does not see where the claimed invention requires permeable or even liquid impermeable electrodes. Moreover, the examiner does not see where Dempsey discusses the desirability of either permeable or liquid impermeable electrodes. All Dempsey discusses is that its electrodes must be gas permeable. That doesn't mean its electrodes are thereby liquid impermeable. Dempsey also presumably desires hydrophobic electrodes, but being hydrophobic is not synonymous with impermeability. It just means that the any liquid permeating through the electrode would not stick to the electrode.

58. Applicant argues that none of Grot, Uchida or Vanderborgh discloses whether its electrode is hydrophobic enough to withstand being immersed in water. However, the origin of this whole argument about whether any of these electrodes could be submerged in water and not be subject to flooding was initiated by applicant's "new evidence" of Surampudi, which applicant alleged showed that you couldn't put Nafion in an electrode at a concentration of greater than 10% without causing flooding. However, the examiner has discussed in detail why Surampudi is irrelevant towards Grot, Uchida or Vanderborgh because Surampudi utilizes no further wetting treatments whereas each of Grot, Uchida and Vanderborgh do utilize further wetting treatments. Moreover, the examiner introduced Cisar which shows that Nafion including

in an electrode will not inherently be plagued by flooding (par. 60 from the 6/14/2010 office action). See also par. 62 from the 6/14/2010 office action, which addressed explained that it is not even necessary for the electrode of Dempsey to be submerged in water either.

59. In response to par. 61 from the 6/14/2010 office action, applicant states that they need only discuss the obviousness of Nafion because Grot only disclosed embodiment used Nafion. However, the examiner's point in par. 61 remains. Except for a couple of claims, the claimed invention is not drawn to just the use of Nafion, Dempsey is not limited to the use of Nafion (col. 6, l. 57 - col. 7, l. 3), and Grot is not limited to the use of Nafion (col. 9, ll. 59-63, claims 1 and 3). If neither the claims being examined nor the prior art is limited to the just Nafion, then why would the analysis of the claims with respect to the prior art have to be limited to just Nafion?

60. Applicant urges that Cisar does not establish that Nafion has hydrophobic characteristics. First, this point appears to miss the larger issue as to why Cisar was introduced in the previous office action. The examiner introduced Cisar to show that a Nafion containing electrode is not inherently prone to flooding as the applicant was urging with Surampudi. The relevant issue here is not whether Nafion is hydrophilic or hydrophobic, but whether an electrode containing Nafion can still have its wetting properties controlled. For Grot, Uchida and Vanderborgh, the answer to that question was clearly yes because they utilize further wetting controls for the electrode. Second, applicant appears to equate the examiner's discussion of "hydrophobic character" as being the same thing as hydrophobic. In the discussion of Cisar, the examiner did not say Nafion was hydrophobic, but could possess hydrophobic character or could be made more hydrophobic by having higher backbone to sulfonic ratios. That much is irrefutable. The backbone of Nafion is a perfluorinated polymer (the same backbone as Teflon), which is clearly a

Art Unit: 1724

hydrophobic component. The more the mass of this polymer is made up of the hydrophobic polymer backbone, the more hydrophobic the polymer will be. As to applicant's request for further proof of this, Cisar says that higher sulfonic content would increase water retention (col. 8, ll. 57-59). If higher sulfonic content gives rise to higher water retention (i.e. hydrophilic character), then it naturally follows that a lower sulfonic content would retain water less and would be more hydrophobic.

61. Applicant continues to discuss Dempsey's use of flooding of one side of the electrolyte and how they believe Nagata and Tomantschger '166 will change Dempsey's principles of operation. The examiner has covered these topics in depth in previous office actions and will not reiterate those points here.

62. With respect to the examiner's point about Tomantschger '166 only disclosing the use of a hydrophobic binder for the electrode when a solution electrolyte is utilized (par. 68 from the 6/14/2010 office action), applicant urges that Tomantschger '166 gives no indication that the use of a solid electrolyte would solve the leakage problems affiliated with the use of a liquid reservoir for hydrating the electrolyte. This argument is entirely confusing. First, Tomantschger '166 never expressed any concern about the reservoir leaking, but only the liquid electrolyte leaking when liquid electrolyte is being utilized. Because the Nafion embodiment of Tomantschger '166 would have no liquid electrolyte, there would be no problem with the electrolyte leaking away. Applicant appears to have made up a hypothetical problem for Tomantschger '166 (i.e. the possibility of the hydrating reservoir leaking), and then urged that Tomantschger '166 never suggested that this hypothetical problem would have been solvable without hydrophobic electrodes. Second, it is entirely unclear why applicant believes the

reservoir leaking would be a problem considering that applicant has urged again and again that Nafion is only hygroscopic. If the electrolyte of Tomantschger '166 was hygroscopic, then any water leaking from the reservoir would have been readily soaked up by the hygroscopic electrolyte. What would impel water to permeate from the supposedly extremely hygroscopic electrolyte to the much less hydrophilic electrodes that would only contain a minority amount of Nafion?

63. Applicant's various arguments in section V starting on p. 41 (note there is no section IV), appears to reiterate arguments that they have made throughout the prosecution concerning Dempsey, Uchida, Grot, Vanderborgh (e.g. Dempsey's electrode is hydrophobic and that Dempsey relies on flooding of the membrane). The examiner has previously addressed the issues related to Dempsey (most recently par. 59-62 in the 6/14/2010 office action). The examiner has also addressed the arguments related to Uchida and their use of a separate coating of Nafion (see the arguments above as well as par. 63 from the previous office action). The examiner has addressed the issue of permeability or impermeability of an electrode above. The examiner has addressed the relevance Surampudi and the Nafion data sheet in par. 60 of the affidavit. The examiner has addressed the issue of Dempsey with respect to Nagata and Tomantschger (par. 52-55 of the 12/30/2009 10/621,637 office action and par. 66 and 67 from the previous office action). No further comment on these portions of the remaining arguments is necessary, and the examiner will focus below only on the arguments that have not been covered in detail before.

64. As to the whole issue of Schroeder's paradox and the evidentiary teaching of Onishi, applicant's argument appears to be that Nafion will take up less water in the vapor phase than in

the liquid phase, and therefore Dempsey and/or LaConti would not have substituted the vapor humidified Nafion for water humidified Nafion. This argument is not persuasive for a number of reasons. First, applicant is essentially saying that one of ordinary skill in the art would not have done what LaConti already says can be done (col. 11, ll. 41-45) based on evidence (Onishi) that was published more than 20 years after the presumed time of the invention. How can one of ordinary skill in the art at the time the invention be held accountable for the contents of a paper published more than 20 years after the time of the invention? Second, the examiner doesn't see any rejected claims in this prosecution that address the issue of vapor humified electrolyte over liquid water humidified electrolyte. Third, even if liquid water was known to provide a higher water content for the membrane, this still wouldn't read away from the use of vapor transport. In particular, Dempsey teaches that the membrane to be utilized is initially soaked in 100 °C water (col. 7, ll. 5-8). If a membrane is initially soaked in water before use (and already has the highest possible water content), then the vapor transport is merely functioning to keep the membrane hydrated (i.e. merely replacing any water that evaporates).

65. Applicant continues to traverse the examiner's use of res judicata. In particular applicant refers to the section 1214.01(I) as evidence that an affirmed rejection can be overcome. However, this apparently only pertains to rejections under 37 CFR 14.50(b) and none of the rejected claims have any rejections made under 37 CFR 14.50(b). As stated before (see par. 46 of the 12/30/2009 office action in the prosecution of 10/621,637), prosecution can not be reopened except for the subject matter to which the new rejection was applied (also in MPEP 1214.01(I)).

66. Applicant urges that the examiner cannot summarily rely on finding in an earlier Board decision to refuse consideration of the applicant's argument. The examiner has not ignored any of the applicant's arguments. See the response to arguments above and par. 59-71 of the 6/14/2010 office action.

Conclusion

THIS ACTION IS MADE FINAL. Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to KAJ K. OLSEN whose telephone number is (571)272-1344. The examiner can normally be reached on M-F 6:00-2:30.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nam X. Nguyen can be reached on 571-272-1342. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Kaj K Olsen/
Primary Examiner, Art Unit 1724

November 23, 2010